Dam Removal in New Jersey:
Background, Regulatory Guidance, and Practical Aspects

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Dam removal benefits public safety and welfare, water quality, biodiversity, ecological integrity, and the local economy**.** For these reasons, a consortium of conservation organizations, watershed groups, and other restoration practitioners approached the New Jersey Department of Environmental Protection (NJDEP) to encourage them to address regulatory constraints and modify procedures with the intention of fostering the practice of dam removal in the State of New Jersey. <u>The purpose of this document is two-fold: 1) to provide a clear and concise list of recommendations to the NJDEP based on a review of pertinent background information and existing regulatory language and 2) to provide materials that will support the development of a formal dam removal program in the State of New Jersey.</u>

Background

Rivers are dynamic linear ecosystems that provide habitat for a broad spectrum of aquatic and semi-aquatic biota. They serve as important connections between terrestrial and estuarine environments and are responsible for providing valuable good and services, including clean water for drinking and recreation. New Jersey rivers have, however, been heavily modified by centuries of industrial and urban growth, and the structure and function of these important ecosystems has been compromised. Encumbered by dams or developed floodplains, and contaminated by polluted runoff, many river systems are currently incapable of attaining optimal ecological diversity and functionality and consequently fall short of supporting multiple social benefits (e.g., boating, angling, bird watching).

There are nearly 1,700 dams located on rivers throughout New Jersey. These dams, installed for a variety of purposes, have in many cases, outlived their useful lives. Today, they diminish the quality of the river by preventing the movement of resident and migratory fish and other aquatic organisms. They divide populations, limits access to crucial habitats, and cause further decline of native populations. By converting a free-flowing river to an impounded one, dams dramatically alter the species composition of the aquatic community and lead to elevated water temperatures. They also interrupt sediment transport, which often causes geomorphic impacts downstream (i.e., incision, widening) and deprives in-stream habitat features of necessary sediment supply. Furthermore, sediment impounded behind a dam can create additional maintenance responsibilities (i.e., sediment dredging and lake management) and may affect flooding in adjacent residential areas. Many professionals once saw dams functioning as flood storage, when in fact they can actually intensify the flooding as a result of their failure.

Many of New Jersey's dams are located in areas where bogs and wetlands already existed, or in broad river valleys composed primarily of riparian floodplains. Historic damming of rivers led to losses of ecologically valuable communities ranging from the Atlantic white cedar wetlands and slow moving, highly sinuous streams in the Coastal Plain to the peat bogs and prolific trout streams in the northern portion of the state. Human communities are also directly affected by aging, obsolete dams, which pose a drowning hazard, exacerbate upstream flooding, and are at risk of failure. For these and other reasons, many dams have been recommended for removal by a broad coalition of stakeholders.

The majority of lakes, reservoirs, and ponds in the State of New Jersey are created by dams or obstructions intended to raise the height of the water. Dams, like highways, railroads and levees, have a limited lifespan and require management and maintenance to ensure proper functioning. Without routine maintenance dams can fail – at great cost to the health, safety, and welfare of the public and environment. While many dams have high public value– for example, those that provide a potable water supply to residents or create economically important recreational lakes – many have outlived their intended use and some have fallen into serious disrepair.

Dam removal can help New Jersey restore the ecological functions and services provided by free-flowing rivers and will benefit the region and the resource over time. As dams become obsolete or fall into a state of disrepair, removal is a sensible option for safety, liability, economic, and ecological benefits. Owners are responsible for public safety and liable in the event of failure, so this is often a strong incentive to consider removal. Ecologically, dam removal increases the availability of riverine habitat, reconnects in-stream habitat for resident and migratory fish, helps to mitigate flood-hazards, leads to improved water quality in formerly impounded reaches, repairs degraded wetlands[1], and provides a path by which streams and rivers can be removed from the Clean Water Act's 303(d) list of impaired water bodies. From a recreational standpoint, dam removal improves fishing opportunities and restores unimpeded river access to boaters and other river users. From an economic growth standpoint, the high recreational value of natural assets may be very attractive to new businesses and residents.

With a renewed appreciation for the services provided by free flowing streams and rivers and a better understanding of river systems and processes, efforts are underway throughout the country to remove barriers to restore natural functions and regain societal benefits. The State of New Jersey needs to formally recognize that dam removal can address dam safety concerns, while providing additional ecological and social benefits. As Commissioner Bob Martin states[2]: "*Our regulations and decisions need to be based on sound science, facts and a robust cost/benefit analysis. We will also continue to vigorously enforce our environmental laws to protect the health and safety of all our residents … and we will play a key role in the economic growth of this state.*"

Review of NJDEP Regulations Related to Dam Removal

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[1] as defined by the NJ Freshwater Wetlands Act Rules
[2] http://www.state.nj.us/dep/commissioner/ (Accessed 10 February 2012)

While the benefits of dam removal are numerous, the regulatory framework within the State of New Jersey has created unintended obstacles to the goals and objectives of river restoration. Environmental protection regulations ensure that the State's natural resources and general environment are protected with as little intrusion as possible. These regulations were developed to allow economic development while maintaining the value of our natural resources (e.g., water quality, wildlife habitat, etc.) and ensuring against destruction of the environment. However, when implemented, these same regulations create impediments to river restoration projects, both preventing projects from meeting their full potential and hindering the State of New Jersey from making progress in harnessing the economic and ecological value of restored rivers.

Several regulations relate to dam removal and applicants must meet the conditions of each of these in order to remove a dam. Below, we review each of these pertinent regulations and provide comments and suggestions that we believe will advance the practice of dam removal in New Jersey.

Dam Safety Standards (N.J.A.C. 7:20)

The Dam Safety Standards provide a framework through which a dam removal can safely take place. There are several items listed under NJAC 7:20-1.7(h) that are reviewed by the Bureau of Dam Safety and Flood Control when applicants are seeking to breach or remove a dam. These items can be summarized as follows:

- Sediment management – The Standards specifically state that the applicant must provide a method for stabilization of the lakebed (i.e., sediment and underlying materials).
- Dewatering – The applicant is required to identify a method and rate for dewatering (i.e., draining) the impoundment that ensures no negative downstream impacts and demonstrate that dewatering can be accomplished in a controlled manner. Additionally, controlled dewatering ensures that any initial sediment release is limited.
- Notice to all adjoining property owners– This serves as an avenue to broadly discuss the most common social issues associated with dam removal including : personal or community attachment to the dam and lake or impoundment, potential water supply issues (i.e., groundwater wells), impacts to property values, and historic concerns, among others. Working closely with those who assign high value to the impoundment is critical– the potential benefits associated with the removal of the dam and the loss of the impoundment, and the costs of alternatives (e.g., maintenance, flooding, liability), need to be made clear, all while respecting the interests of the people.
- Environmental effects of the breach – Applicants must assess any potential environmental impacts, positive or negative.
- Impacts on downstream life and property – Applicants must assess any potential impacts to life and/or property, whether positive or negative. This includes assessing possible increases in downstream flooding from a range of flood recurrence intervals including the 10-, 50- and 100-year storms.

Commentary: Identification of the issues within the Dam Safety Standards facilitates the development of competent and consistent investigatory and design approaches for dam removal; however, because of the range of complexities associated with dam removal projects, applicants would benefit from some specific policies and/or guidance related to these items – most notably those that pertain to sediment management and dewatering. For example, knowledge of the maximum allowable quantity of sediment that can be released, preferred rates of dewatering, or suggested components to address regarding the broadly stated need to evaluate "potential effects…upon the environment" would all be useful in developing breach plans. In the absence of such guidance, applications are likely to be inconsistent across projects and, therefore, burden the regulators evaluating the environmental concerns of each project. We believe the process would be more efficient for both applicant and regulator if the NJDEP were to provide specific advice related to these mandatory components, either via broadly distributed written documentation or individual conversation (e.g., mandatory, on-site pre-application meetings with NJDEP Bureau of Dam Safety and Flood Control).

Freshwater Wetlands Protection Act (N.J.A.C. 7:7A)

The New Jersey Freshwater Wetlands Protection Act was developed to comply with Section 404 of the federal Clean Water Act (CWA), which regulates the placement of dredged material or fill within navigable waters of the United States. This section provides States with the ability to request delegation of authority to implement the rules; NJ has chosen to become such a delegated authority. Therefore, all activities within freshwater wetlands, including river restoration, must be approved by the NJDEP in order for the State to ensure its compliance as a delegated authority.

Currently, dam removal is permitted under the Freshwater Wetlands Protection Act via a General Permit No. 18, or GP18. Within the provisions of a GP18, up to one acre can be disturbed before the need for an Individual Permit is required. One alternative which enables projects with greater than one acre of wetland impacts to proceed is to apply for a General Permit No. 16 (GP16) for Habitat Creation and Enhancement Activities.

Commentary: Ideally, any potential (and unavoidable) negative impacts of dam removals on freshwater wetlands should be weighed against the ecological benefits of restoration. Unfortunately, the need for an Individual Permit under the Freshwater Wetlands Protection Act Rules may discourage applicants due to the significantly higher effort involved to show compliance with the rules. Yet, in some cases, the full potential of a dam removal project may only be met if greater than one acre of wetland disturbance is permitted (e.g., when site-specific conditions dictate the need for dredging and grading, and ultimately the need for >1 acre of impacted area).

The alternative is to apply for a GP16 specifically requires a listed "sponsor", which by definition must be a State or Federal agency (e.g., NJDEP, USFWS, NOAA, USACE, the National Park Service, etc.), and therefore precludes private dam owners from applying for a removal via this approach.

While the NJDEP's GP16 uses the language defined by the Federal Nationwide Permit 27 (NW27, from the USACE), the NJDEP has the ability to expand the qualification for a GP16. We suggest that the NJDEP may want to consider adding language to indicate that any dam removal, river restoration, or wetland restoration activity is supported by the State of New Jersey because it contributes to the repair of degraded wetlands and removal of impaired water bodies from the 303(d) list. With the inclusion of such language, the State could automatically be listed as a sponsor for any dam removal, stream, river restoration, or wetland restoration activity and thus allow select projects with broader impacts to be accomplished via a GP16. Under this approach, the limitations of disturbance would not be as restrictive, thereby providing each dam removal project the opportunity to provide the greatest possible benefit.

Flood Hazard Area Control Act Regulations (N.J.A.C. 7:13)

The purpose of this regulation is to "minimize damage to life and property from flooding caused by development within fluvial and tidal flood hazard areas, to preserve the quality of surface waters, and to protect the wildlife and vegetation that exist within and depend upon such areas". If the scope of a dam removal project expands beyond the regulatory authority of the Safe Dam Act, or the obstruction does not meet the definition of a dam in accordance with Dam Safety Standards[3], a Flood Hazard Area permit is required.

Commentary: This regulation defines those activities that can and cannot take place within the flood hazard area and riparian zone; among others, the list of regulated activities includes "alteration of topography through excavation, grading, and/or placement of fill" and "clearing, cutting, and/or removal of vegetation in the riparian zone", both of which are likely to occur with a typical dam removal project. Because this regulation is aimed at 'preservation' and 'protection', there is no identified means for capturing the beneficial impacts of stream restoration projects that are intended to improve or enhance the river ecosystem. The regulations specify the context within which bank stabilization or channel restoration can be approved, however, they also set limits for the maximum allowable amount of riparian disturbance, above which the regulated restoration activity would require mitigation (i.e., through additional riparian planting).

While such requirements are understandable for highly structural channel encroachments such as retaining walls or levees, such restrictions are counterintuitive for those stream restoration projects that will provide ecological benefits that are aligned with the intent of the regulation. Although the regulations provide a logical framework for assessing hydrologic and hydraulic impacts, they should be revised to establish a separate framework for reviewing dam removal and river restoration projects where impacts are limited to the minimum necessary to access the river and conditions are restored or improved post-project. Specifically, revised language should waive the requirement for compensatory mitigation of impacts to riparian vegetation.

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[3] NJAC 7:20-1.7(h) defines a dam as "any artificial dike, levee or other barrier, together with appurtenant works, which is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of dam.:

Recommendations

Based on a review of the above, the following recommendations are presented to the NJDEP for consideration:

- Outline a policy within which dam removal is viewed positively because it benefits public safety and welfare, water quality, biodiversity, ecological, and economic integrity**.**

- Create a stakeholder group comprised of regulatory representatives (Bureau of Dam Safety and Land Use Regulation Program), governmental organizations charged with restoration (USFWS, NRCS, NOAA, ACOE, etc.), environmental NGOs, design professionals, and environmental consultants to address issues of coordination and foster a more productive approach to river restoration in the State of New Jersey. The group would assist in the development of changes to regulatory language and encourage practices that support dam removal and restoration.

- Create a formal dam removal program within the NJDEP Bureau of Dam Safety and Flood Control to advocate for dam removal, share information, assist with outreach, and establish and post measurable goals (e.g., # of dams removed or # miles river reconnected) to monitor and show program success. Models for such a program can be found in the section titled *Guidance Documents to Assist Policy and Regulatory Reform*, below. Such a program would need to incorporate the following changes related to the three regulations most directly impacting dam removal:

    - Develop specific instructions and/or guidance related to those items that are reviewed by the Bureau of Dam Safety & Flood Control when an applicant proposes to breach a dam, as outlined in the Dam Safety Standards *(N.J.A.C. 7:20)*. Guidance could be provided either via written document or in-person conversation (e.g., mandatory, on-site pre-application meetings with NJDEP Bureau of Dam Safety and Flood Control). There is a particular need for guidance related to sediment management.

    - Expand the qualification for a General Permit No. 16 (GP16) for Habitat Creation and Enhancement by providing language in the Freshwater Wetlands Protection Act *(N.J.A.C. 7:7A)* rules to indicate that dam removal is supported by the State of New Jersey because of its ability to contribute to the repair of degraded wetlands and remove impaired water bodies from the 303(d) list. With the inclusion of such language, the State could automatically be listed as a sponsor for any such activity, allowing projects to be accomplished via a GP16 without a federal sponsor. Under this approach, all projects with greater than one acre of wetland impacts could circumvent the need for an Individual Permit.

    - Establish a special regulatory framework for reviewing dam removal and river restoration projects under the Flood Hazard Area Control Act Regulations *(N.J.A.C. 7:13)*that recognizes the value of restoration and holds restoration projects to a different standard than development projects. Revised language should waive the requirement to mitigate for impacts to riparian vegetation resulting from dam removal and river restoration activities. To require such mitigation is financially burdensome, and is redundant when the proposed work is meant to restore riparian function and improve water quality.

- When reviewing multiple permit applications for dam removal projects waive or reduce application fees.

- Formally establish a single point of contact within the Bureau of Dam Safety and Flood Control for those interested in dam removal. Ideally, this individual should have a technical understanding of dam removal and river processes, and a thorough understanding of the permitting process. This person would be authorized to shepherd applications through the permitting process, coordinate efforts within the NJDEP and mediate internal deliberations, and ensure that permit applications are reviewed in a timely manner. Following the meeting between the NJDEP and restoration partners in October 2010, Mr. Darin Shaffer has been acting in this capacity. We believe that formalizing this role is an important step to streamlining the permit process for dam removal in New Jersey.

Guidance Documents to Assist Policy and Regulatory Reform
A number of States, Federal agencies, interagency organizations, and NGOs have developed guidance for the removal of dams. These documents are listed as follows:

Examples of Permitting Guidance

- American Rivers, 2006, "Permitting Dam Removal: The State of (Several) States", ASDSO National Conference, Boston, MA, September 2006 (http://www.americanrivers.org/library/reports-publications/permitting-dam-removal.html)
- Commonwealth of Massachusetts, Riverways Program, "Fact Sheet: Dam Removal Permitting (http://www.mass.gov/dfwele/der/pdf/factsheet_permitting_final.pdf)
- New Hampshire, Department of Environmental Services, "Guidelines to the Regulatory Requirements for Dam Removal Projects in New Hampshire", 2003, revised 2007 (http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/des-wd-03-35.pdf)
- Wisconsin, Department of Natural Resources (http://www.dnr.wi.gov/org/water/wm/dsfm/dams/removal.html)

Several states that have developed specific programs for dam removal and even celebrate their success by posting completed projects on their websites. These states' successes in dam removal are a result of setting policy that *specifically* supports dam removal as a means of compliance and environmental restoration. NJDEP should not be concerned about setting such proactive or position policy, as this approach has precedents throughout the country.

Investigatory and Design Guidance Documents –Many states have also prepared design and investigatory guidance for the removal of dams. These documents can be found as follows;

- Massachusetts, "Dam Removal In Massachusetts, A Basic Guide for Project Proponents", December 2007 (http://www.mass.gov/eea/docs/eea/water/damremoval-guidance.pdf)
- Massachusetts, "Dam Removal and the Wetland Regulations", December 2007. (http://www.oregon.gov/OWEB/docs/pubs/SmallDamRemovalGuide.pdf?ga=t) (http://www.mass.gov/Eoeea/docs/eea/water/damremoval_guidance.pdf).
- Oregon, "Small Dam Removal in Oregon", December 2008 (http://www.oregon.gov/OWEB/docs/pubs/SmallDamRemovalGuide.pdf?ga=t

Guidance for Pre- and Post-Dam Removal Monitoring –Monitoring should be a key component of the restoration process, both to ensure adaptive management for a specific project and to improve the practice of dam removal. While there are numerous documents which describe methods for monitoring, the Gulf of Maine Council on the Marine Environment (a group of US and Canadian governmental and non-governmental agencies) developed a particularly notable handbook titled "Stream Barrier and Removal Guide." This guide provides pre- and post- dam removal monitoring guidelines that provide methods to assess impacts on sediment transport, stream channel morphology, fish passage, macroinvertebrates, water quality, and riparian vegetative communities. The guide is available online at: http://www.gulfofmaine.org/streambarrierremoval/

Frequently Asked Questions: Dam Removal

[*Following the creation of a formal dam removal program, the State of New Jersey will need to be able to quickly address a broad variety of questions about dam removal from dam owners and other parties. The following provides an overview of typical inquiries, which could be further developed by a stakeholder group into a format suitable for distribution*].

Q. What is a dam?
A. Generally speaking, a dam is a barrier built to obstruct or redirect the flow of water.

In New Jersey, dams are defined as "any artificial dike, levee or other barrier, together with appurtenant works, which is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of dam."[4]

Within the Pinelands region, only those barriers with a height greater than eight (8) feet, a reservoir greater than 100 acres in area or a contributing drainage area exceeding 1 square mile are identified as "dams".

Q. Who regulates dams in New Jersey?
A. The NJDEP Bureau of Dam Safety & Flood Control administers the State's Dam Safety program. To learn more about the program or state regulations, visit the Bureau's website at http://www.nj.gov/dep/damsafety.

Q. Why are dams built?
A. Dams are constructed to create reservoirs to provide a secure and reliable source of drinking water, to create recreational lakes and ponds, or to function as an aspect of an industrial operation.

Q. *How do dams affect rivers?*
A. Dams impede flow and create artificial habitat, which is often of reduced quality because stagnant conditions that lead to increased water temperatures and decreased oxygen availability. Some dams have regulating elements to lower or raise the levels in the impounded areas, further affecting flow and aquatic life. Dams block passage for migratory and resident fish species and other creatures that rely on unobstructed rivers and riparian corridors for movement. Dams may also trap sediment, preventing its delivery to downstream reaches – this is an important function of natural rivers.

Q. Why are some dams being removed?
A. Dams are removed when the costs associated with their presence outweigh the benefits they provide. "Costs" associated with the presence of dams include environmental impacts, safety liability, and economic costs associated with maintenance and insurance; while "benefits" might include aesthetic or recreational value, or functions such as hydropower, flood control, or irrigation. Often these dams no longer serve the purpose for which they were installed or benefits are limited.

[4] Dam Safety Standards, N.J.A.C. 7:20-1.2

From an ecological standpoint, dam removal restores natural river hydrology, provides habitat for important riverine species, recreates migration pathways and helps to improve water quality and a complex suite of important physical and chemical processes.

Q. How quickly do rivers recover after dam removal?
A. Rivers are very dynamic and resilient systems. Experience has shown that natural river systems can be restored relatively rapidly after dam removal. Furthermore, areas exposed from drawing down the impoundment revegetate quickly, often within weeks of removal, as a result of natural regrowth or plantings that are included as part of the project.

Q. How will dam removal impact flooding?
A. Dam removal does not increase downstream flooding. A commonly held misconception is that all dams provide flood control. In fact, only a small percentage of dams provide flood control benefits and those dams were expressly built for that purpose. In New Jersey, approximately 6% of dams truly provide flood control. The remaining dams are essentially “run-of-the-river” (spillway is bank to bank of channel) or provide little flood storage.

Since most dams do not significantly affect or control downstream flooding, their removal will not cause a significant change in downstream flooding. In some cases, dam removal can actually decrease flooding upstream of the former dam location because the river can naturally adjust to flow conditions and water is not impeded by structures in the river.

Q. How does dam removal affect fish?
A. Dam removal benefits riverine fish in many ways, including: (1) increased species diversity through the removal of obstructions to upstream and downstream migration; (2) restored natural riverine habitat; (3) restored natural seasonal flow variations; (4) elimination of siltation of spawning and feeding habitat above the dam; (5) improved transport of plant debris, small rocks, and nutrients to pass below the dam, creating healthy habitat; (6) elimination of unnatural temperature variations below the dam; and (7) removal of dam turbines that kill fish.

Q. What happens to the fish and wildlife that were in the impoundment/lake?
A. These areas will begin the process of reverting back to an unobstructed riparian corridor following dam removal. Much of the wildlife that used the impoundment – such as birds, turtles and fish – will either adapt to the restored river conditions or relocate to other suitable habitat. In some cases, lake-adapted species may be purposely relocated prior to dewatering the impoundment. The newly created habitat can also attract species that prefer the open river environment.

Q. How does dam removal impact recreation?
A. Dam removal can actually increase fishing opportunities since free-flowing rivers provide a greater variety of habitat for native species. Removal frequently helps restore cold water fisheries such as trout, and anadromous fish such as American shad, Atlantic salmon, and river herring which now have access to upstream reaches. So, while the fishery will certainly change, a greater variety of fish and fishing opportunities is likely to result.

In addition, removal of the dam creates safer conditions for paddlers and boaters and allows for passage without having to portage the dam or encounter dangerous hydraulic conditions at the toe of the dam.

Q. Are there any negative environmental impacts of dam removal?
A. Short-term impacts of the dam removal itself can include increased water turbidity and habitat disturbance from construction equipment. These short-term impacts are quickly outweighed by the rapid recovery of the system and the long-term benefits that result. The loss of lake species is supplanted by the new balance of species. Like any newly created vegetative area, the formerly inundated lakebed needs to be planted with native material that will thrive in the area and buffer against invasive plants.

Q. Who decides that dams should be removed?
A. In most cases, the dam owners are the decision-makers; whether because an owner decides the costs of continuing to operate and maintain the dam are too much, or they may be motivated by parties interested in restoring habitat for migratory and resident aquatic species. However, if there are public safety concerns, state dam safety offices can order that a dam be repaired or removed. If the dam in question is a regulated hydropower facility, the Federal Energy Regulatory Commission (FERC) can order its removal for both environmental and safety reasons.

Q. Will the removal of a single dam make a difference if other dams are not removed?
A. Any dam removal will restore that reach of river, although some rivers are so heavily developed and dammed that removal of one dam on that river will only return river habitat to a small portion of the river. Generally, dams that have been identified as a priority for removal are strategically located and removal will open up a section of the river critical to fish and wildlife and/or recreation. In some cases, this additional section of river is enough to sustain crucial populations of endangered or threatened species of fish, mollusks, and other wildlife.

Q. How do I identify a dam's owner?
A. Dams may be privately-owned by individuals or business, or publically-owned by state or federal agencies, local governments, or public utilities. Ownership of a dam can be assessed by contacting the state dam safety office or conducting parcel research at the County Assessor's Office. Whether your interest is to restore habitat or improve safety (or both), it is critical to speak with the dam owner early in the process – without the cooperation of the owner, the project will not happen.

Q. What is the typical sequence of events for a dam removal project?
A. The typical sequence of events is as follows:

- Conduct background research & identify the dam's owner – learn as much about the dam as possible, including information about its history, hazard classification, safety record, current and past uses, construction type, and ownership. Consult the NJDEP Bureau of Dam Safety and Flood Control, local historical societies and watershed groups, and state and municipal records. Once the owner is identified, determine their willingness to explore removal of the dam.
- Once the owner's cooperation is assured, a feasibility study and an engineering design are needed. Hire an engineer to evaluate the feasibility of removal and prepare a design plan. The long-term effectiveness of river restoration is a function of site-specific conditions; therefore, once a project has progressed to a design phase, it is critical to assess conditions that may influence the restoration approach or outcome. The presence of sediment, hydrologic and hydraulic regimes, and infrastructure should all be considered. Pre-removal monitoring should also occur during this stage.
- Secure state and federal permitting – Completed designs are submitted for permits.
- Construction – The dam is removed and the river and banks are restored.
- Implement post-removal restoration and monitoring.

Q. How long will the dam removal process take?
A. The length of time from initiation of a project through removal varies greatly and may last from one year to several years. The timeline depends upon the complexity of the pre-removal activities, including the feasibility study and design, the length of time to acquire permits, the timing of allowable construction activities, and fundraising. The actual dam removal can take anywhere from a few days to a few months.

Q. How do I select a qualified engineer?
A. Contact local or regional groups for assistance in identifying an engineering firm with dam removal experience. These resources may include the NJDEP Bureau of Dam Safety & Flood Control, the regional US Fish and Wildlife Service office. Your local municipal engineer may be able to refer you to someone with dam removal experience. A good source of information is to contact organizations with experience working on dam removal projects such as area conservation groups. Organizations like American Rivers can provide a list of qualified consultants with dam removal experience in New Jersey and neighboring states.

Use the attached "Dam Removal Scope of Services Checklist" (Appendix A) to help you evaluate a consultant's qualifications based on the skills needed to do complete a project.

Q. What needs to be considered to decide whether or not dam removal is possible?
A. Several items should be considered when deciding whether or not to remove a dam – either during a formal feasibility study or a less formal process. Most of these are issues that can be addressed during the design phase, and should not prevent a project from moving forward:

- Determine whether or not threatened & endangered species (or species of conservation concern) are present and whether they may be impacted by construction activities or the loss of the impoundment.
- Determine whether or not sediment is present behind the dam – How much? What type? (e.g., sand, silt, gravel). If sediment is present, determine whether it is contaminated with metals, PCBs, or dioxins. The potential for contamination can be addressed by determining if there are any current or historical sources of contamination upstream.
- Identify infrastructure that may be impacted by removal; for example, bridge piers or utilities.
- Determine whether the dam is serving any current function. For example, is the dam diverting water to a canal or millrace? Is there a drinking water intake or a dry hydrant present? Once existing uses are identified, alternatives for providing those uses must be explored.
- Determine the any potential social or cultural impacts that would result from the removal of the dam and a change in a community resource.

Q. What about impacts to historic resources?
A. Dam removal can result in changes to historic structures. Project partners work with the local and state historic commissions as part of the design and construction process. In many cases recognition of a historic structure is established through an on-site interpretive display or reuse of some of the historic material on site. For more information, read the American Rivers publication "Dam Removal and Historic Preservation: Reconciling Dual Objectives" which is available online at
http://www.americanrivers.org/library/reports-publications/dam-removal-and-historic.html.

Q. How are dams (physically) removed?
A. Because dams and rivers vary greatly, physical removal strategies and techniques also vary. Techniques may include the use of controlled explosions, but more often than not, dams are removed using heavy construction equipment such as hydraulic hammers and backhoes.

A typical construction sequence might include:

- Notching the dam to draw down the reservoir and better control the flow of water;
- Managing for any sediment from behind the dam through full or partial excavation, stabilization, controlled release, or some combination thereof.
- Removing the structure itself; and
- Post-removal restoration activities, including reshaping the streambanks and planting native vegetation.

Q. How much does it cost to remove a dam?
A. Because the size, location, and construction of dams vary so greatly, the cost to remove an individual dam can range from tens of thousands of dollars to hundreds of millions of dollars.

Q. Is dam removal cost effective?
A. Yes. Dam removal is a one-time expense that is, in most cases, less than the cost of repair or replacement. Benefits also accrue over time; removal eliminates the expenses associated with maintenance and safety repairs, as well as direct and indirect expenses associated with fish and wildlife protection (e.g. fish ladders and mitigation for fish mortality). In addition, removal often generates income from newly available recreation opportunities – including fishing, kayaking, and rafting – which may actually result in a net economic benefit.

Q. Who pays for dam removal?
A. Generally a dam removal involves multiple funding partners. There are several programs that provide funding for dam and barrier removal projects. Federal agencies often support dam removal projects including the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), and the U.S. Corps of Engineers (USACE). Other organizations with regional offices, including Fish America, Trout Unlimited, American Rivers, and others are able to provide guidance for locating regional funding opportunities. Natural resource damage settlements and required mitigation also provide opportunities for funding projects. Of course, the dam owner may also contribute to the costs associated with removing their dam. In some instances, settlement of state or federal natural resource damage claims can be a source of dam removal funds. For more information on that course, contact the NJDEP Office of Natural Resource Restoration for guidance.

Q. How do I obtain a permit for a dam removal in New Jersey?
A. Currently, dam removal projects are permitted under the Freshwater Wetlands Act through a General Permit #18 (GP18)). Additional permits may also be required depending upon the nature of the project and its location.

Anyone wishing to pursue dam removal must submit a Dam Construction Permit Application (on the NJDEP Dam Safety website at http://www.nj.gov/dep/damsafety/forms.htm). The requirements of the New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.7 Sections h-i) Application Stage must also be met.

APPENDIX A

Dam Removal Scope of Services Checklist

Use this checklist with potential engineering consulting services to provide estimates on the steps and costs for Feasibility Study, Design, and/or Construction. *If you aren't familiar with these terms, a highly qualified professional advisor will take the time to go over the terms with you, so be sure to ask!*

Project: ______________________________

Location: ______________________________

Project Goals: ______________________________

I. Data Collection & Start Up

___ A. Identification/listing of project partners (and identification of roles)
___ B. Identify existing & past uses of dam
___ C. Field Assessment – Investigation/site visits
___ D. Data collection & review of existing material
(Mapping, FEMA data, utilities & upstream structures, etc.)
___ E. Aerial photographs/orthophotoquads
___ F. Ownership & flowage rights
___ G. Dam inspection
(Collect past inspections from state & prepare new inspection if needed)
___ H. Investigation of infrastructure (i.e. utilities, docks, retaining walls, intakes, etc.)
___ I. Historic/archaeological study
(Professional analysis and/or informal investigation of site's past)
___ J. Initiate Section 106 reporting requirements (*if needed*)
___ K. Identify known Threatened & Endangered Species within project limits/contact authorities
___ L. Project context
(Utilization of a watershed plan; understanding of greater system issues, etc)
___ M. Set Photo points & start photographing site

II. Survey

___ A. Survey (site & in-channel) Type:________________________________
(Property boundaries, limits of upstream impoundment, utilities)
___ B. Impoundment bathymetry
___ C. Preparation of base maps Scale & Contour Interval: _________________________
___ D. Easement maps
___ E. Wetland delineation & vegetation survey
___ F. Delineation of other resource areas (i.e. high water line, banks, regulated areas, etc.)
___ G. Property deed review

Continued on next page

III. Soil Investigation and Analysis

- ___ A. Soil investigation plan w/consultation from state (i.e. Sediment Sampling Plan)
- ___ B. Sediment probes to determine depth (and quantity)
- ___ C. Soil & bedrock borings (mechanical)
  (Borings maybe needed to assess archeological history of site too)
- ___ D. Collection of impounded sediment sample(s)
- ___ E. Collection of downstream sediment sample(s)
- ___ F. Collection of upstream sediment sample(s)
- ___ G. Inspector during sampling (& field procedure write up)
- ___ H. Identification of contamination elsewhere on site
  (Do you need a Phase I or II Environmental Assessment?)
- ___ I. Physical lab analysis
- ___ J. Chemical lab analysis
- ___ K. Suitability analysis & summary
  (Compare sediment quality results to state standards)
- ___ L. Sediment transport analysis
  (Potential for sediment transport w/ passage alternative; embankment stability)
- ___ M. Soil disposal management options
- ___ N. Streambank stability analysis

IV. Hydrology & Hydraulics

- ___ A. Hydrology
  (Gage data or hydrologic model)
- ___ B. Stream gauging
- ___ C. Groundwater monitoring
- ___ D. Hydraulics modeling
- ___ E. Potential Impacts to flooding
- ___ F. Preparation of profiles and cross sections
- ___ G. Bypass hydraulics
- ___ H. Water intake assessment & redesign
- ___ I. Water supply assessment
  (Identify impacts on wells & ground water, if removing dam)
- ___ J. Fire suppression analysis/alternatives
- ___ K. Bridge scour analysis
- ___ L. Analysis of upstream (stability) & downstream (capacity) structures (if removing dam)
- ___ M. Physical model

Continued on next page

V. Channel Investigation/Analysis

___ A. Selection of a reference reach
___ B. Geomorphic & ecological assessment of channel
___ C. Channel stability analysis
___ D. Restoration design of channel (banks, bed material, stream bank vegetation, habitat, etc.)
___ E. Substrate characterization (i.e. visual, pebble count, measure, etc)

VI. Fisheries

___ A. Consult with local and regional fisheries resource managers
___ B. Identify and describe target fish species
___ C. Assessment of fisheries
(Collect passage requirement data for target species)
___ D. Final model of each site to ensure that no velocity barriers exist
___ E. Determination of Upstream and/or Downstream barriers to fish passage.
(i.e., culverts, dams, waterfalls, etc.)

VII. Conceptual/Draft Design

___ A. Identify potential issues
___ B. Alternatives analysis
(Benefits, limitations, upstream/downstream impacts of various fish passage alternatives)
_____ 1. No action
_____ 2. Repair or replace dam
_____ 3. Full dam removal
_____ 4. Partial dam removal
_____ 5. Rock ramp
_____ 6. Bypass channel
_____ 7. Fishway (ladder or lift)
_____ 8. Combination of methods
___ C. Design recommendations
(Meet with agencies, regulatory authorities & project partners to discuss alternatives prior to written recommendation)
___ D. Environmental evaluation of recommended alternative
___ E. Conceptual design plans
___ F. Assessment of recreational & access opportunities
___ G. Preliminary design Plans - based on agency & partnership feedback
(design plan, S&E, construction sequence, utilities, notes, details)
___ H. Preliminary cost estimates
___ I. Cost/benefit analysis of recommended design (if required)
___ J. Design report
(Summarizes data & analysis; can submit with permits)

Continued on next page

VIII. Permits

___ A. Pre-application meeting with regulators
(Identification of required permits & critical issues)
___ B. Prepare permit applications (local, state, federal)
___ C. Public meetings
___ D. 8-1/2"x11" plans (for ACOE permits) Other sized plans required: ___________________
___ E. Revise FEMA mapping (if required)
___ F. Post-filing support & revisions

VIII. Final Design

___ A. Final design (includes site restoration & mitigation if required)
___ B. Structural & geotechnical investigation & design (if needed)
___ C. Dam repair design (if fish passage is selected over removal)
___ D. Planting plan
___ E. Site access
___ F. Final design plans
___ G. Final sediment & erosion controls
___ H. Project manual/specifications (if going out to bid)
___ I. Final quantities & cost

IX. Project Management & Coordination

___ A. Kick-off meeting
___ B. General coordination/management (includes meetings)
___ C. Conference calls
___ D. Regular updates/reporting to project partners
___ E. Assistance with grant identification and preparation
___ F. Identification of cost saving techniques
(Scopes broken into tasks, identification of tasks that can be done externally, identification of scheduling issues that might increase costs, etc.)

X. Public Outreach

___ A. Develop a public outreach plan for the project (consensus building approach)
___ B. Letter of intent (sent to affected property owners)
___ C. Prepare visuals (Colored set of plans, renderings, photo-renderings, photographs, etc.)
___ D. Public outreach meetings
___ E. Development & coordination of stakeholders group (facilitation)
___ F. Develop press plan (press releases, press events, etc.)
___ G. Web page
___ H. Project dedication ceremony
___ I. Public education opportunities

Continued on next page

XI. Construction Administration

___ A. Bid support (encourage "value-engineering")[5]
___ B. Inspection services
___ C. Construction management
(Includes meetings, progress reports, change orders, & approve shop drawings)
___ D. Prepare as-built/record drawings
___ E. Regular reporting

XII. Monitoring

___ A. Development of monitoring plan
___ B. Monitoring meetings (with project partners and interested parties)
___ C. Pre-project monitoring
___ D. Monitoring during construction
___ E. Post project monitoring

Other items to discuss when interviewing a prospective engineering consultant

- Method of payment
- Design/bid/build or Design/build options
- Breaking scope into tasks with individual costs
- Type of contract (hourly rate, lump sum, not-to exceed, etc.)
- Liability & insurance (project bonding, upfront agreements, etc.)
- Termination or suspension policy
- Project schedule (incentives/penalties)
- Contract documents (terms of agreement)
- Sub-contractor coordination and management (roles and tasks requiring sub-contracting)
- Deliverables (Items & formats)
- Number of copies needed
- Travel time and expenses
- Miscellaneous project expenses

[5] Value engineering means modifying a design that would increase efficiency of construction and reduction of cost without loss of safety and intent of the initial design.